Power management 101:

A quick guide to getting the most out of your hardware

E·T·N
Powering Business Worldwide

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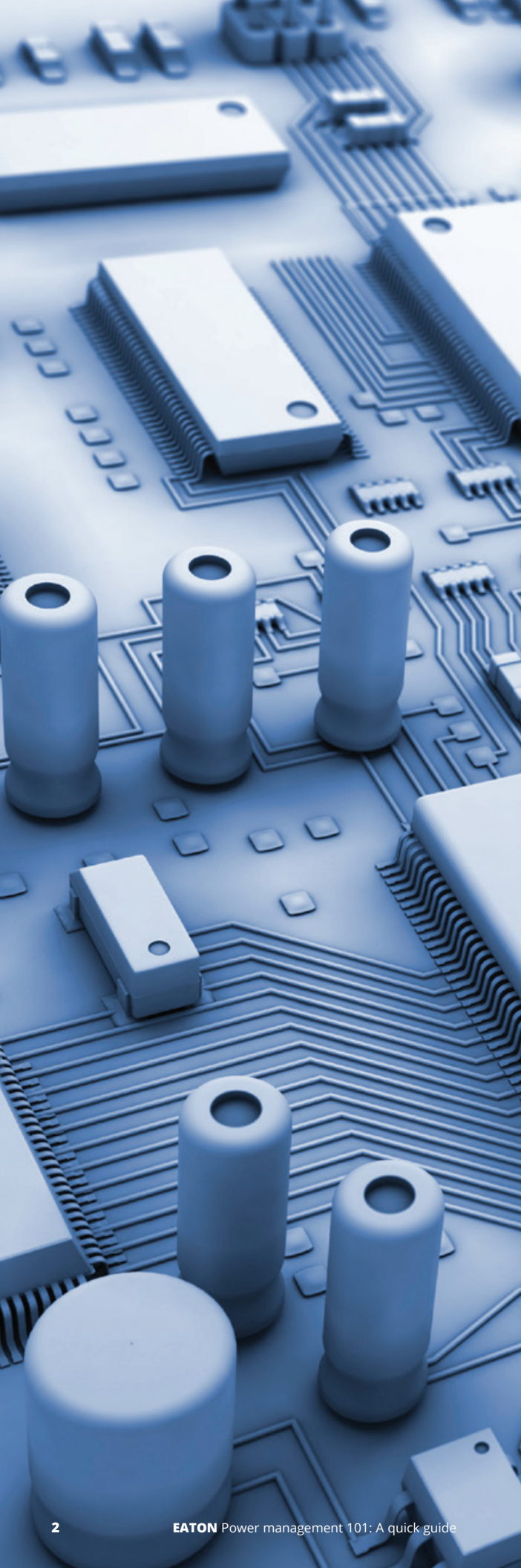
Table of contents

Introduction

Network connectivity basics

Beyond the network card

How to select a power management solution

Introduction

Why is monitoring and managing your power infrastructure important?

There's just no downplaying the devastation that can result from unexpected downtime.

From substantial financial losses to irreversible brand and reputation damage, power outages take a toll on businesses of all sizes, across every industry.

That's why it's important to safeguard your IT equipment with a power management solution that can keep your critical applications always-on during interruptions.

There are a range of options on the market today, from a basic network card to multiple software platforms.

Whether you'd like to monitor a single uninterruptible power supply (UPS), integrate with leading virtualization platforms or manage an entire data center, cutting-edge connectivity options cannot only enhance your business continuity, but can significantly slash your operating expenses, reduce infrastructure requirements, and boost productivity and responsiveness even during a prolonged outage.

Above anything, these tools can help simplify your life. Regardless of your location, you can receive advanced alerts from afar, trigger advanced actions like migrating virtual machines, and make data actionable through faster, scalable interpretation.

Monitoring and management software is the perfect complement to your UPS and power distribution unit (PDU) devices.

> **DID YOU KNOW?**
>
> Software-defined power is the continuous management of power via virtualization platforms and disaster recovery techniques to optimize power and cooling consumption, and ultimately save users money, improve operational flexibility and avoid unplanned downtime.

Why is a UPS not enough?

Although UPSs are typically rugged and reliable, they do require ongoing monitoring and support.

Connected devices allow you to continuously monitor and diagnose the state of your environment, batteries and power sources, along with the condition of the UPS's internal electronics.

Monitoring your UPS without remote capability is like driving in the rain without windshield wipers—you may be protected from the downpour, but your visibility is hindered.

More and more, IT professionals are focusing on highly secure, reliable remote site management, making it necessary to monitor network devices remotely, 24/7.

With a network card, you can securely monitor and control an individual UPS by connecting it directly to the network. Its features keep you informed of problems as they occur, ensuring uptime in the event of an extended power outage.

While a UPS protects the attached load during a power outage, power management software is required to ensure all work-in-progress is saved and sensitive electronic equipment is prepared if a power outage exceeds the battery runtime of the UPS. Without software, the UPS simply runs until its batteries are depleted and then drops the load.

In addition to this basic functionality of UPS connectivity, you should consider the following monitoring and manageability capabilities that are available today:

- **Power event notifications,** including emails, pop-up alerts and text messages to pre-designated recipients
- **Logging** of power events
- **Advanced capabilities** in virtual environments, including integration into VMware's vSphere/ESXi, Microsoft's Hyper-V and Nutanix Ready Acropolis Hypervisor (AHV)
- **Dedicated battery monitoring** and advanced service notifications
- **Remote monitoring** by service personnel from the UPS manufacturer
- **Automated** responsive measures to power events

UPS ports and connections

Check out the pictures below to get familiar with the physical connections on a UPS and how they function.

RS-232 and USB ports

RS-232 and USB ports establish communication between the UPS and a computer. When the communication cable is installed, power management software can exchange data with the UPS. The software polls the UPS for detailed information on the status of the power environment.

ROO port

The remote on/off (ROO) connection allows the remote action of the button to switch on/off the UPS.

RPO port

The remote power off (RPO) connection is used to shut down the UPS remotely when the contact is open. This feature can be used for shutting down the equipment connected to the UPS and the UPS itself by thermal relay, for instance, in the event of room over-temperature. When RPO is activated, the UPS shuts down the output and all its power converters immediately. The UPS remains on to alarm the fault. The RPO circuit is an IEC 60950 safety extra-low voltage (SELV) circuit that must be separated from any hazardous voltage circuits by reinforced insulation.
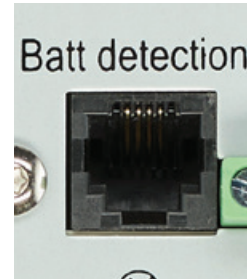
Battery detection port

The battery detection port is used to notify the UPS that an extended battery module (or modules) are connected.

OH YEAH! SOCKET TO ME!

Output relay port

The UPS output relay provides a normally open and closed dry contact. The relay can be programmed through the liquid crystal display (LCD) to energize on a specific alarm or UPS status to allow easy interfacing with building and industrial automation equipment.

Cable connections

Cable connections deliver surge protection for network phone lines, cable TV and satellite applications.
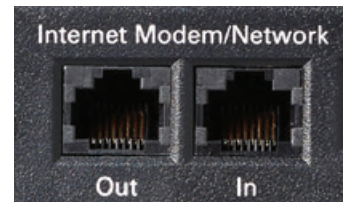
Data line protection

An internet modem/network connection is used to provide protection from back-door power surges.

Network connectivity basics

So, you have a UPS. Now what?

Why a network card?

Network cards allow secure monitoring and control of an individual UPS by connecting it directly to the network.

This connectivity is the conduit for your device, providing status, alerts, remote capabilities and valuable power data. The notification features keep you informed of problems as they occur, avoiding shutdown in the event of an extended power outage, always keeping your business information safe.

Remote communication card types

IT-based	SNMP enables your unit to be accessible via the internet to monitor the software
Facilities	Modbus, BACnet, SNMP
Relay	Provides alarm and health status of your UPS through relay contacts

Compare Eaton network cards

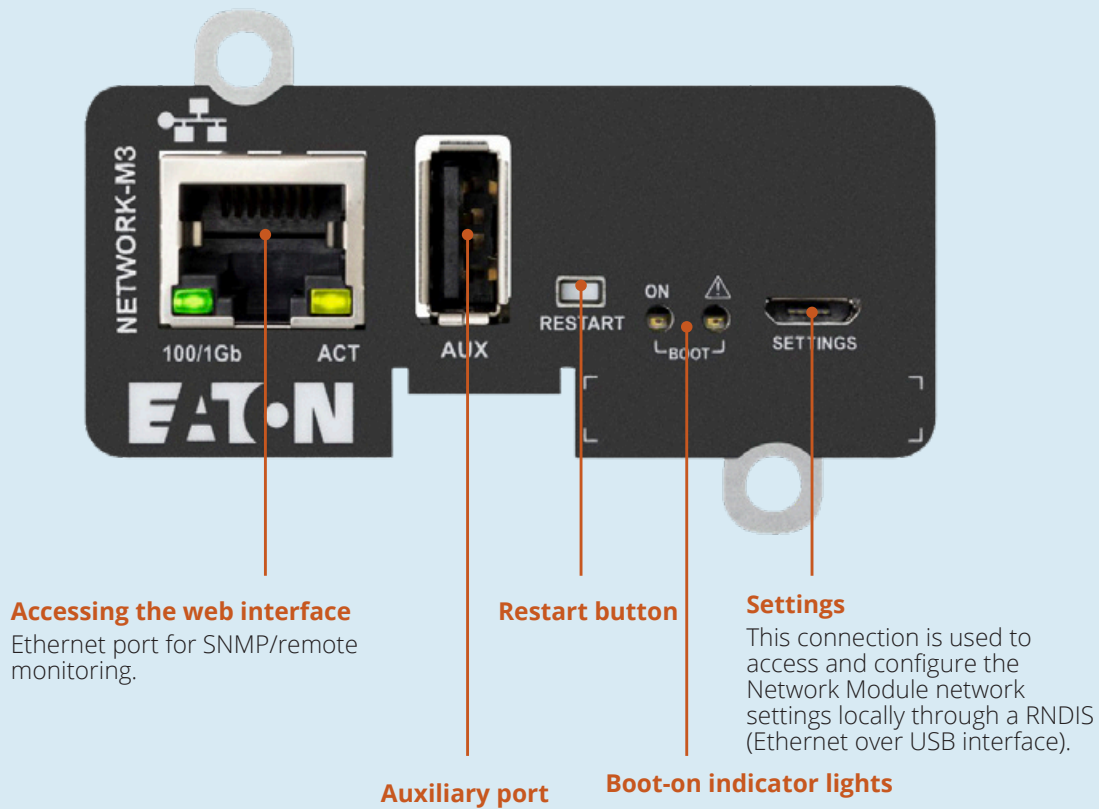|	
Gigabit Network Card	Provides a Gigabit Ethernet connection and enables secure UPS monitoring over HTTPS web browser interface, SNMP v1/v3 protocol and email alarms. In addition, up to three environmental monitoring probes can be attached to obtain humidity, temperature, smoke alarm and security information.
Relay Card-Mini Slot (MS)	Has isolated dry contact (Form-C) relay outputs for UPS status: utility failure, battery low, UPS alarm/OK or on bypass.

DID YOU KNOW?

Network UPS Tools (NUT) also support many **UPS** and **PDU** models, providing control and monitoring features with a uniform management interface.

Eaton Gigabit Network Card

Anatomy of a network card

Accessing the web interface
Ethernet port for SNMP/remote monitoring.

Restart button

Settings
This connection is used to access and configure the Network Module network settings locally through a RNDIS (Ethernet over USB interface).

Auxiliary port

Boot-on indicator lights

Why are network cards a higher investment than Peripheral Component Interconnect (PCI) cards?

Q. I'm looking to add a network card to my UPS. In what ways is it more of an investment?

A. UPS and PDU network cards are like small computers. It's not the cost of the materials that drive the price, but rather the engineering and development required to make sure the card is compatible with network communication protocols and various operating systems. You get the luxury of all the application features and accessories built into one network card, linked with security.

Q. Why aren't network cards automatically included with every UPS?

A. Not every user wants or requires a network card, and including one would increase the price of the UPS. This is because all the application features and accessories are conveniently built in to the network card, allowing for better security and, overall, a better investment.

Reduce your cybersecurity risk

Eaton's Gigabit Network Card is the first in the industry to meet both UL 2900-1 and IEC 62443-4-2 cybersecurity standards, ensuring it has been reviewed and tested and meets the benchmark of this trusted brand. Chain-of-trust encryption, password management and a user-configurable firewall are three key enhancements included in the Gigabit Network Card.

What are UL 2900-1 and IEC 62443-4-2?

With more connected devices than ever, Eaton understands there is an increasing risk of cybercrime occurring through network-connected devices. UL and IEC have developed these standards to assess the vulnerability of connected devices to known malware/exploits and protect organizations from these risks. These certifications are global standards for connected device cyber-security. Products undergo extensive testing, including static code reviews, vulnerability assessments and risk mitigation capabilities. The Eaton Gigabit Network card was assessed for SSH, SNMPv3, NTP, SMTPS, DHCP and MQTT via TLS.

Encryption:

- Root-of-trust device authenticates all attached firmware and enables only secure protocols
- Uses the most current version of Transport Layer Security protocol (TLS)
- Secure SMTP for email alerts
- User-configurable firewall provides an additional layer of security to protect the Gigabit Network Card and the UPS system from unauthorized access and cyberattacks

Password management:

- Required change of password on setup
- Configurable requirements for password complexity
- Certificate-based authentication in machine-to- machine connections— no username/password information saved on the client machine, separate certificates for each protocol

Beyond enhanced cybersecurity, what does this card feature?

- Integrates with Eaton's Brightlayer Data Centers suite and compatible Eaton UPS systems
- Network card can upgrade firmware on select UPS systems
- Remote UPS monitoring and management, allowing for real-time response to power events and reinforcing business continuity
- Computers can be rebooted remotely with load segment controls or automatically
- Gigabit speed for compliance with networking equipment and gigabit-only data center networks
- Zero-touch provisioning; auto-configuration commissions devices faster, saving time exponentially in large-scale deployments.
- Visibility into power metrics for identifying problematic trends and proactively detecting aging power hardware components

Eaton Network-M3 installed (top right on UPS)
Eaton.com/Network-M3

How to verify UPS communication

Properly configured communications ensure IT managers can respond to alerts and take corrective actions to:

☑ **Run a test email.**
If your UPS is equipped with a network card, run a trial email.
Sometimes changing email servers or domains can cause settings to be out of date.

☑ **Check the software.**
Make sure the UPS and network card both have the most up-to-date versions.

4 basic ways to manage and communicate with your UPS

Single UPS:

Network card.

You can usually monitor a single UPS through an optional network card. Network cards are essentially on their own servers, so they record event history, send email and text message alerts, and provide remote access to real-time status. Using a network card is usually the best way to manage one UPS.

Shutdown:

Network card and monitoring software.

If your UPS is protecting servers, you need to ensure continuous uptime in order to prevent data loss in the event of a prolonged power outage. The software can communicate directly with the network card (or over USB and serial if needed) to register itself and receive alerts to initiate soft shutdown of your IT systems.

Multiple UPS installations:

Network cards and management software.

For multiple UPSs spread out across a network closet, campus or enterprise, you will need software that is designed to aggregate and manage your power devices (UPSs and network-enabled PDU products).

Virtualization:

Network card and virtualization software.

You will want to integrate power into your virtualization platforms. Look for power management software that can integrate seamlessly into your existing dashboards. From there, you should be able to enable safe shutdown of virtualized servers—even servers in clusters running vCenter or XenCenter. Live migrations can be triggered to transparently move virtual machines to an available server on the network for data integrity and zero downtime.

What to look for in a UPS

No network card

- **Basic communications**
- **Basic monitoring**

Eaton 5S

Slot available for network card

- **Basic communications and monitoring standard**
- **Can add card for robust capabilities**

Eaton 5P UPS with network slot

Bundled with a network card

- **Robust capabilities right out of the box**

Eaton 9PX UPS with network card

What it takes to control a UPS
From the experts at StorageReview

The ideal network card should enable secure UPS monitoring and quick response time.

You should seek a network card with a management interface that displays status information, such as synoptic diagrams, key measures and active alarms, and has the following user interface features to best monitor your devices.

Alarm configuration allows users to set temperature thresholds and be notified when the UPS hits specific conditions.

The **sensor commissioning** feature provides users with three options: Discover, Delete and Define offsets.

- **Discover** launches the sensor discovery process, which can populate the table if sensors are found.
- **Delete** simply removes the selected sensor.
- **Define** adjusts the temperature and humidity offsets.

The **network module firmware** section monitors the information of the embedded firmware and allows users to upgrade the network module's firmware. Users can also activate one of the embedded firmware versions, reboot the network module operating system, and save and restore the network module settings from this section.

The **power outage policy** setting controls how the network module shutdowns protected servers and appliances. Users can prioritize and schedule shutdown actions as well.

The **agent shutdown sequence timing** section allows admins to set up when specific agents, such as servers or arrays, can be powered down. The feature allows for sequential and immediate shutdown depending on the specific needs. Users can set policies for each power source connected to the UPS. The shutdown policy can be enabled or disabled via the check-boxes. If they are disabled, the policy will be grayed out. For example, in our use case, the load shedding policy starts a shutdown for a set time in seconds or when the battery's capacity reaches the set capacity (%).

With **scheduled shutdowns,** users can turn off the UPS or individual load segments on a specific day and time. Your network card should ideally indicate that this can be used for energy savings by scheduling shutdowns outside of office hours. It can improve cybersecurity by powering down network equipment when a threat is suspected.

The **pairing with shutdown agents** section is a way to connect the UPS network module with shutdown agents based on matching certificates. If the network was set up in a secure and trusted network, new agent connections are automatically trusted and accepted within a given timeframe. The rest cannot connect.

The **power** section shows the product input and output measures in voltage, frequency (input and output), power and current (output).

Controls are displayed for the entire UPS, showing its status, associated commands and the pending action.

The **status** shows the current mode of the UPS. Commands give users available actions, and pending action shows users the delay before shutdown and delays before startup.

![StorageReview logo]

To view the full article, visit
www.storagereview.com/eaton_5p1500rc_5p_ups_review.

Beyond the network card
How power management software can make an IT pro's life easier

One of the most important issues facing IT managers today is software/ hardware integration.

Perhaps you already know the importance of a network card, and you want to elevate your remote capabilities. We've outlined some of the leading features and benefits today's power management delivers.

And remember, as your environment scales, so should your power management tools. Whether yours is a small deployment of UPS units and rack PDUs, a sophisticated data center housing thousands of servers and millions of datasets or anything in between, a power management vendor should be versatile enough to adapt with you.

DID YOU KNOW?

Automation platforms reduce physical infrastructure cost and space, minimize data center operating cost, and increase productivity and responsiveness.

YOU'LL HAVE PLENTY OF TIME TO FOSSILIZE!

First and foremost, consider the reporting. Custom reports can analyze your data and identify trends, while providing capacity planning and deployment recommendations.

To show how Eaton can give you the power to automate, monitor, visualize and predict, visit Eaton.com/BrightlayerDataCenters.

1 Automation
- **Always keep systems online**
- **Resolve issues intelligently and with less human intervention**
- **Get the most out of your power devices**

2 Monitoring
- **Keep eyes on your power infrastructure**
- **Identify and resolve issues faster**
- **Run a more efficient IT environment**

3 Visualization
- **Gain a holistic view of all devices; detect aging power hardware components**
- **Improve system and application reliability**
- **Mitigate risk through data**

4 Predicting
- **Predict power component failure**
- **Respond proactively with timely maintenance**
- **Reduce the time, cost and headache of unplanned power events**

The power of automation

Avoid disaster with automated responses and resolutions.

Keep IT devices running during power or environmental events with software that monitors, manages and controls power equipment in physical or virtual environments.
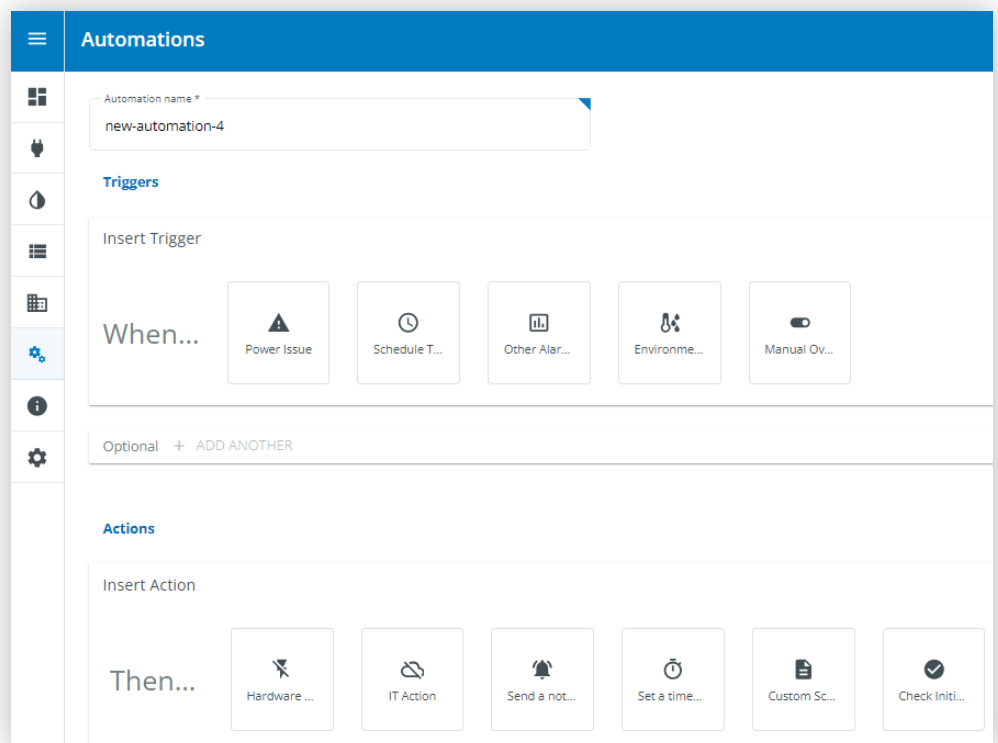
Eaton offers two software solutions in our **Brightlayer Data Centers suite** to help you monitor your IT infrastructure for faster response times and increased uptime. **Distributed IT Performance Management (DITPM) software** was designed for environments with more than 25 UPSs and/or PDUs, while **Intelligent Power Manager (IPM)** provides the intelligence and automation needed for smaller environments with 25 or fewer UPSs and/or PDUs.

The products provide:

- **Policy-based remediation.** Trigger advanced actions like deploying custom scripts and migrating a virtual machine (VM) during specific power and environmental events.

- **Intelligent resolutions.** Leverage integrations with industry leaders (DITPM: Microsoft and VMware; IPM: Cisco, Dell, HPE, Microsoft, Nutanix and VMWare) to keep critical applications running and automate resolutions for your entire network vs. server-by-server shutdown and potential downtime.

- **Extended UPS battery runtime.** Migrate VMs and/or gracefully shut down non-critical VMs to enable host shutdown to increase system uptime and minimize generator load.

Configure automation rules in IPM.

> GET THE JOB DONE WITHOUT HUMANS? THAT'S NOTHING NEW.
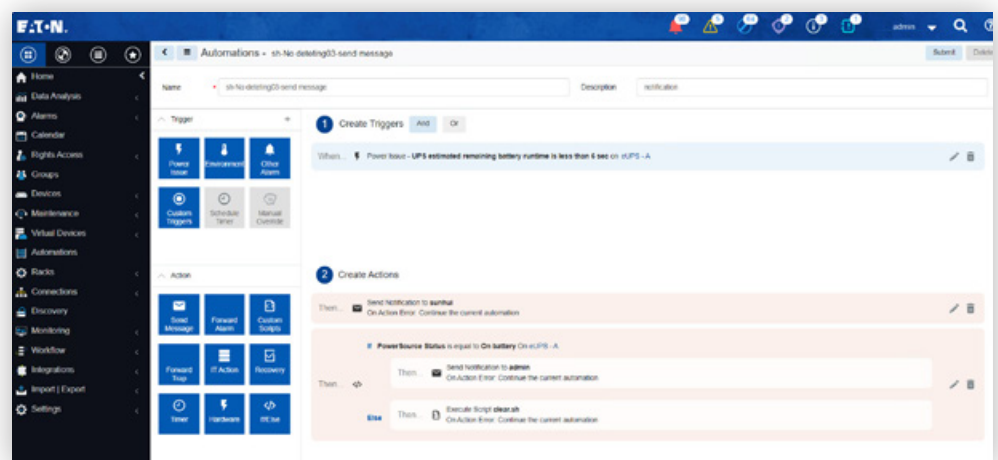
Configure automation sequences using DITPM's IT automation wizard.

Considerations by application

Here are a few additional considerations to help you determine what you need based on your environment, application or industry.

Remote office/branch office/network closets

- Since these setups are physically located in a different location than your data center or main IT environment, your power infrastructure should be remote-controllable.

- Your power infrastructure setup should keep track of all assets and include reports on when maintenance should occur, specifically when to replace aging UPS batteries.

- Look for a power manufacturer that has integrations with leading technology providers like Cisco, Dell, HPE, Microsoft, NetApp, Nutanix and VMware to ensure you keep up with the latest IT trends and simplify management.

- Considering you will be remote, ensure your power management infrastructure can strategically power cap servers and keep critical loads running longer if you come across a disaster. This will allow you to automatically take actions to maintain your critical loads and employee connectivity.

Data centers

- Your power management infrastructure should be able to monitor everything in your environment.

- Your setup should help you plan your deployments and manage existing equipment.

- You should be able to identify root causes and provide fail over analysis to avoid critical failures.

- If you're a colocation provider, your power infrastructure should provide the ability to report by customer/cage for billing and other reporting purposes.

These applications can be applied across industries including healthcare, finance, education (K-12 and higher education), manufacturing and government/DoD.

How to select a power management solution

Know your power!

IT budgets are rarely robust enough to pay for everything on your wish list.

It's important to re-evaluate your needs based on power usage before you buy. This worksheet will give you a baseline to help you optimize your power management software options, maximizing your dollars invested while accounting for growth.

Focus on ROI

☐ **Which software solution will help me increase productivity and save on cost?**

Be sure to calculate the cost of downtime for your business. By using a software package that requires less hardware, power, cooling and management, you can benefit from cost savings over time. And with increased efficiencies, there will be no need to re-create your work in progress.

Remote monitoring

☐ **Do I want to remotely shut down a host in a cluster without needing to install shutdown agents on each host or each virtual machine?**

☐ **Do I have a mixed environment that I need to monitor? Is my software vendor-agnostic?**

☐ **Do I need remote monitoring coupled with my UPS service plan?**

Business continuity and disaster recovery

☐ **How will I ensure data integrity in the event of an extended outage?**

When evaluating your power management software options, consider how each integrates with your hypervisor to automate VM migration, safe shutdown and reboot. This will save you time when a power interruption occurs. Additionally, you'll want to initiate planned migrations to a cloud recover site and allow for extended runtime to critical applications with load shedding.

☐ **Is my software capable of security-authentication and physical security linkage?**

☐ **Is the firmware on my network card genuine, authorized firmware?**

Management ease

☐ **Do I have a global view of my network?**

It's important that you have access to a complete log of events and UPS or PDU utility data on one screen—often done from a PC with internet browsers. You should ensure you have centralized alarms, and organize data by customized views, along with event logs for preventive maintenance of your entire equipment base.

☐ **Do I want it to plug directly into your virtual dashboard?**

For example, with VMware, **Eaton has a solution that integrates** into the existing dashboard you manage.

☐ **Do I want to initiate planned migrations?**

☐ **Do I want to perform load shedding?**

☐ **Does my software have inventory management?**

☐ **Do I have a variety of UPSs, PDUs and other devices from different manufacturers that need to be monitored?**

The majority of IT pros don't just buy from one vendor. So make sure the management platforms you select have the ability to look at data across your devices. To be truly vendor-agnostic, automation and monitoring platforms need to be policy driven.

In data center environments, ensure your management platform can monitor from utility entry to virtual machine.

Consolidate

☐ **Is my IT environment consolidated to run as efficiently as possible?**

Review the efficiency of your IT environment to make sure your servers are provisioned efficiently. Consider consolidation versus growth based on today's virtualized environments to determine if it's time for an upgrade.

☐ **Do I have auto-discover equipment within my connected environment?**

Scalable

☐ **Does my software allow for growth within my IT environment?**

You may want to grow even more in the future. If you're managing multiple environments, locations and pieces of equipment, you'll want to ensure your software can scale along with your UPS and PDU equipment for years to come.

☐ **Does my environment have multitenancy capabilities?**

☐ **Can I make firmware and configuration software upgrades?**

WHEN IT COMES TO PDUS, THERE'S NO ROOM FOR MONKEY BUSINESS!

Which power management solution is right for you?

Find your match.

PDU connectivity options

There are a number of management tools available to IT professionals

When it comes to rack PDUs, it's important to have visibility into your IT power infrastructure. The more complex your network, closet, campus or enterprise, the more remote access and control you will want your software to enable for receiving critical information on the health of your data center.

Network connectivity allows you to see the status of your PDU and remotely reboot or turn outlets and sections on/off from a web browser. This is the most basic form of monitoring, and typically an included feature. Using a web browser may be a good choice for small, standalone environments with one to 25 rack PDUs.

Environmental monitoring probes are connectivity devices that enable you to collect temperature and humidity readings in the rack environment and monitor the environmental data via the onboard LCD screen or remotely using a Telnet connection or standard web browser. You can also monitor the status of two contact closure devices, such as door switches.

Distributed IT Performance Management (DITPM) software will help you manage all of your distributed IT environments. With DITPM, you can:

- Know what's happening in all locations with detailed and definable real-time alerts
- Resolve equipment issues quickly by remotely power-cycling UPS and PDU outlets
- Locate equipment easily within a specific rack by site to facilitate troubleshooting and changes
- Update firmware remotely to protect against cybersecurity threats and support standardization
- Detect new assets automatically to streamline change management and improve mapping
- Automate responses like load shedding and safe shutdown to extend runtime and protect data

As your environment scales, so does Eaton. Whether yours is a small deployment or a sophisticated data center housing thousands of servers and millions of datasets, or anything in between, our platform is versatile enough to change with you.

Module being removed without removing power to the PDU

Three daisy-chained environmental monitoring probes with a rack PDU

Measure power consumption at the PDU outlet level

Acquire more accurate and detailed data by measuring power at the outlet level.

Gain energy analysis at a deeper level to make informed decisions and assist with effectively deploying equipment.

Compare efficiency between manufacturers and understand what drives power usage so you can make intelligent decisions to reduce power consumption.

Advanced LCD pixel display with hot-swap capability

Eaton's 0U PDU models feature a hot-swap network management card that can be replaced without the need to power down your rack. Increase uptime while enhancing serviceability and saving on unnecessary service calls. The menu-driven pixel display allows for easy setup and troubleshooting.

I DON'T FEEL YOUR PAIN. BUT HERE'S A HANDBOOK ANYWAY.

For more information visit
Eaton.com/ManageSmarter

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